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RESPONSE OF BENTHIC COMMUNITIES IN MERL EXPERIMENTAL ECOSYSTEMS TO LOW LEVEL, CHRONIC ADDITIONS OF No. 2 FUEL OIL*

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ABSTRACT

The macrofauna and meiofauna of three oiled and three control experimental ecosystems at the Marine Ecosystems Research Laboratory (MERL) were followed for 25 weeks of semi-continuous additions of an oil water dispersion of No. 2 fuel oil. Water column hydrocarbon levels were maintained at about 190 ppb, and after 20 weeks 109 μg/g dry weight fuel oil hydrocarbons were recorded in the top 2 cm of sediment.

This simulated chronic oil pollution resulted in a highly significant decline in the number of macrofaunal and meiofaunal individuals in the experimental tanks compared with the controls. The effect was apparent on the numbers of individual macrofaunal species and on all metazoan meiofaunal groups.

INTRODUCTION

From laboratory experiments it is very difficult to predict the effect on ecosystems of an environmental factor such as a pollutant. Interactions at higher levels of

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organisation in the ecosystem, such as between and within trophic levels, will sometimes amplify, sometimes dampen or even totally reverse the direct effect of the environmental factor of interest, giving ecosystem effects that could not have been predicted from single-species laboratory studies. Microcosms allow experimental manipulations and replication not possible in the natural ecosystem, thus retaining some of the analytical advantages of simpler laboratory experiments, while still providing much of the complexity of nature.

The Marine Ecosystems Research Laboratory at the University of Rhode Island maintains twelve cylindrical 13 m^3 experimental ecosystem tanks (1·8 m diameter × 5·5 m). Of these, six have been devoted to an experiment on the effects of No. 2 fuel oil on shallow-water marine ecosystems. Sediments are collected from a sandy mud bottom of Narragansett Bay where the numerically dominant macrofauna are *Nucula annulata* and *Mediomastus ambiseta*. The water column in the ecosystem tanks is pumped from the Bay and maintained at a slow flow rate of 20 litres an hour, giving a turnover time of 30 days.

METHODS

A large van Veen grab was used to fill trays of sediment from Narragansett Bay. These trays were placed intact into the large ecosystem tanks. Each of the six experimental ecosystem tanks was sampled monthly and the Bay was sampled seasonally. Paired 85·5 cm^2 samples (used for community respiration and nutrient flux studies) were taken from each tank, and starting with the November samples, ten random 4·16 cm^2 samples were taken monthly. Most months, five samples were taken within equal central and peripheral areas of the tanks to test for effects of proximity to the wall. The coring apparatus consisted of a simple core tube and ball valve on the end of a long pole mounted in a rigid frame which allowed precise positioning with respect to the sides of the tank. The core was gently pushed to a depth of 10 cm to minimise disturbance of the sediment surface. The same area was not sampled twice unless several months had elapsed between samples. Small cores from every month and large cores from August, 1976 to January, 1977 have been sorted for macrofauna.

All samples were initially washed through 500 μm, 300 μm and 44 μm standard soil sieves. All individuals retained by the 300 μm and 500 μm screens, except the typical meiofaunal groups such as nematodes, ostracods and copepods, were identified to species and counted as part of the macrofauna.

In the following, meiofauna designates all metazoa and Foraminifera which pass a 500 μm sieve but are retained on a 40 or 44 μm sieve, except for temporary meiofauna (= juvenile macrofauna), where only specimens passing a 300 μm sieve have been counted as meiofauna, in order to avoid overlap in size categories with macrofaunal studies.

In addition to the samples from the experimental ecosystems, we took six series of seasonal samples of the *Mediomastus–Nucula* community in the Narragansett Bay area where the sediments were originally collected. Transects of twenty adjacent 35 cm^2 cores (cylindrical plastic tubes) were diver-collected each sampling period so that the patchiness within the community could be analysed. For the macrofauna, these samples were processed in the same way as the tank samples. A separate set of five to six widely spaced cores was used for meiofauna. The earliest meiofaunal samples were sorted individually but once an idea about field variability had been gained, samples were pooled in groups of five or six diver cores per sampling occasion, in order to save time. The cores were sliced in 0–2, 2–6 and 6–10 cm depth layers.

For the MERL tanks, the ten monthly 4·16 cm^2 cores per tank taken for macrofaunal analysis, starting in November, 1976, were also used for the meiofaunal analysis. Since meiofaunal work is much more time-consuming, all ten samples from each tank were pooled and mixed and this composite sample was analysed, giving at least triplicates for each treatment, but no information on within-tank variability.

The formalin-preserved and Rose Bengal-stained samples were fractioned on a series of sieves of 500, 300, 100 and 40 μm mesh size for the Bay samples whereas, for the MERL tank samples, the finest sieve used for meiofauna was 44 μm. (This may have lead to a few per cent more nematodes being retained on the finest sieve in the Bay samples.) The larger meiofaunal fractions were sorted as a whole, while the finer fractions were subsampled, using either a subsampler (Elmgren, 1973) or, for the heavier material, a microsplitter, similar to that described by Olsson (1975). The exact procedure has varied slightly but normally, for a 35·3 cm^2 diver core or a composite 41·6 cm^2 tank sample, the subsample examined would be for 500 μm and 300 μm fractions: 1/1, 200 μm: 1/8, 100 μm: 1/40, 40 μm or 44 μm: 1/200.

Despite initial attempts to limit the number of larger animals in the system, differences occurred between the tanks in the number of large individuals capable of significantly affecting the community structure. At the end of the study, all the sediment in the tanks (1·1 tons per tank) was washed through 0·25 in sieves (0·125 in sieves for the water column) and the large animals retained were enumerated and weighed.

The temperature range in Narragansett Bay is −2 to 24 °C and the variation in the tanks is 0 to 24 °C. The salinity varied from about 24 to 30 ‰ in the Bay and 28–30 ‰ in the tanks (Candace Oviatt, pers. comm.).

REPLICATION—MACROFAUNA

Before the start of the oil experiment in February the numbers of individuals per small core were not significantly different among any of the tanks. The similarity of

numbers was great between cores within tanks as well as between tanks. The 4·16 cm^2 core samples show some patchiness, particularly in numbers of *Mediomastus* and *Yoldia*. *Nucula*, however, is less patchy and it is possible to demonstrate the similarity between tanks using one-way analysis of variance ($F = 1{\cdot}16$ for 9 and 79 degrees of freedom).

OIL EXPERIMENT—NUMBERS OF MACROFAUNAL INDIVIDUALS

On 6 December, 1976 a single 2·5 g dose of No. 2 fuel oil was added to tanks 2, 7 and 9. This initial single oil dose produced no significant effects on either the meiofaunal or the macrofaunal benthos. Starting on 14 February, 1977, three tanks (2, 7 and 9) were given repeated, semi-weekly oil additions (shaken with seawater to form an

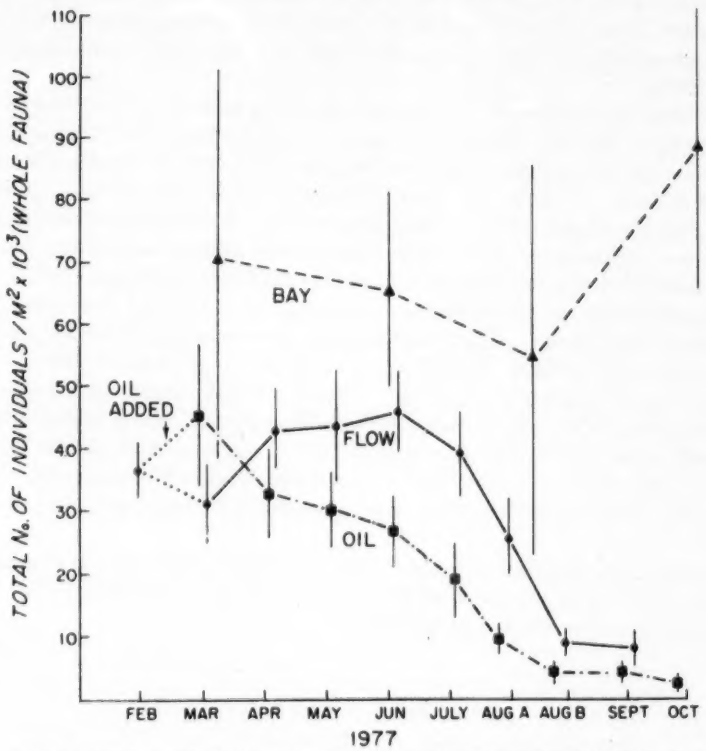

Fig. 1. Mean and 95% confidence interval for the total number of macrofaunal individuals per square metre in Narragansett Bay (dashed line, filled triangles), flow (control) tanks (full line, filled circles) and oil tanks (dotted dashed line, filled squares) from the start of the second oil experiment.

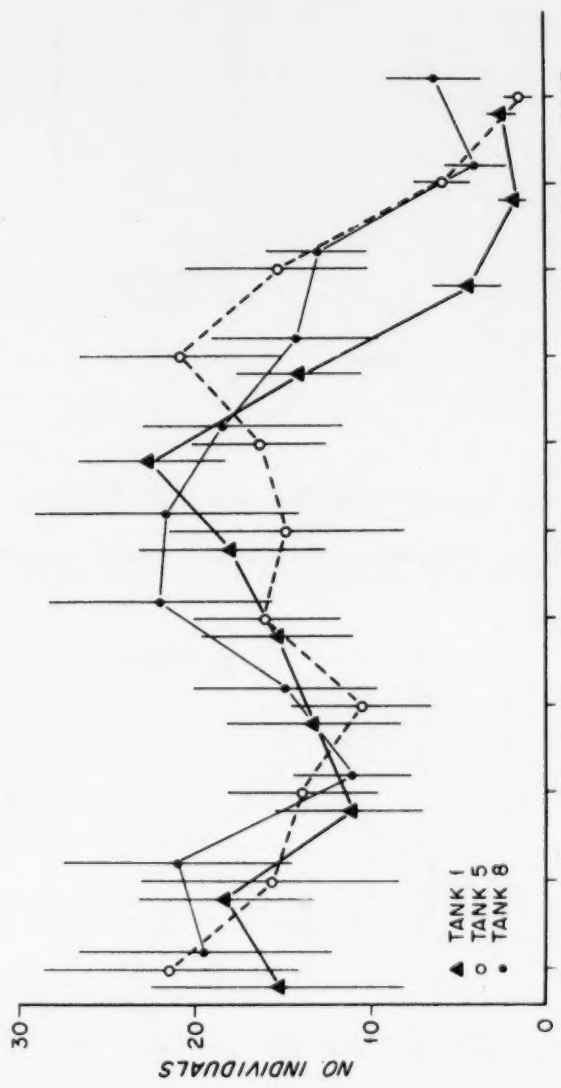

Fig. 2. Mean and 95% confidence interval of the total number of macrofaunal individuals per 4·155 cm² core in each of the control tanks (1, 5 and 8) from 16 November, 1976 to September, 1977.

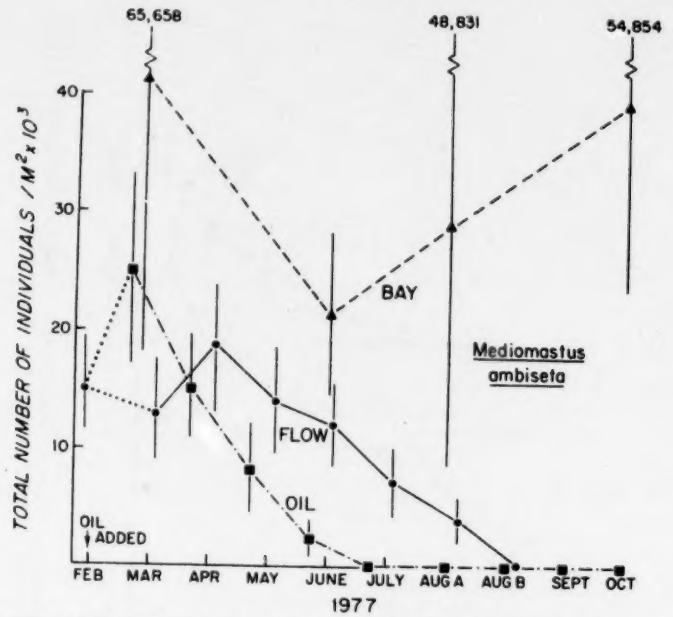

Fig. 3. Mean and 95% confidence interval of the density of *Mediomastus ambiseta* in Narragansett Bay, flow (control) tanks and the oil tanks from the start of the second oil experiment.

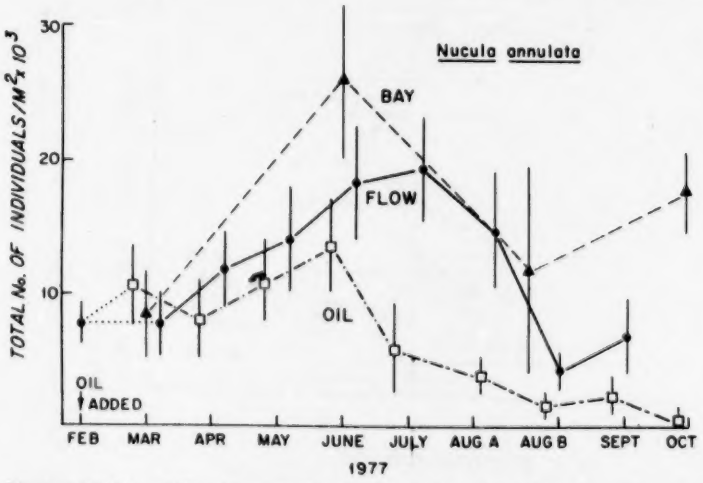

Fig. 4. Mean and 95% confidence interval of the density of *Nucula annulata* in Narragansett Bay, flow (control) tanks and the oil tanks from the start of the second oil experiment.

oil water dispersion) over a five-and-a-half month period, with the last addition on 1 August, 1977. Oil levels in the surface water ranged from 100 to 600 ppb with a mean concentration for the period of about 190 ppb (Gearing *et al.*, 1979). A total of 108 g of No. 2 fuel oil was added to each tank.

Figure 1 shows the changes in total number of individuals per square metre following the addition of No. 2 fuel oil to tanks 2, 7 and 9. The number of individuals in these oiled tanks began to diverge from the control tanks in April and were significantly different in June, July and August. The numbers of individuals in all tanks declined sharply during the summer months. Figure 2 compares the three control tanks (1, 5 and 8) with one another. Tank 1 was significantly different from the other two tanks in August. The only obvious difference between the fauna in this tank and the others was the presence of large predatory crabs, two *Libinia emarginata* and one *Ovalipes ocellatus*. This suggests that the summer decline resulted in part from the increased activity of these large predators. Tanks 1 and 8 showed an increase in numbers in September, suggesting the start of recovery in the prey species.

The numbers of the most common species, *Mediomastus ambiseta*, showed a continuous sharp decline after an initial increase in the month following oil addition (Fig. 3). By July, *Mediomastus* was almost absent from the oil tanks. *Mediomastus* in the control tanks did not show the initial increase and did not begin to decline until May. The differences between oil and control were significant in the June and July samples and in the first August sample.

The numbers of *Nucula annulata* in the control tanks were not significantly different from those in the Bay except at the very end of the experiment (Fig. 4). The numbers of individuals in all tanks and in the Bay increased during April, May and June as new recruits entered the population. This increase continued into July in the control tanks whereas the oil tanks showed a sharp, significant decline in July. The densities in oil and control tanks remained significantly different from July to September when the experiment ended.

At the beginning of the oil experiment in March the densities of *Yoldia limatula* were not significantly different from those of the Bay (Fig. 5). Subsequent increases in numbers of new recruits in the control tanks resulted in densities significantly different from the Bay densities. This seasonal increase in new recruits in the tanks was somewhat delayed in the oil tanks but the differences were not significant. The oil and control tanks diverged significantly in June and remained different through the first August sampling.

Large animals at the end of the experiment

The number and wet weights of large animals were significantly higher in the control tanks than in the oil tanks (Tables 1 and 2). Most of the individual species followed this pattern with the notable exception of *Nereis virens*. This species was present only in the oil tanks where an average of nine individuals per tank were

TABLE 1

TOTAL NUMBER OF LARGE ANIMALS FROM EACH TANK RETAINED BY SIEVES AT THE TERMINATION OF THE EXPERIMENT. MOST OF THE ANIMALS WERE OBTAINED BY SIEVING SEDIMENTS THROUGH $\frac{1}{4}$ in SIEVES. THE NUMBERS IN PARENTHESES ARE ANIMALS RETAINED BY $\frac{1}{8}$ in SIEVES WHEN THE WATER COLUMN WAS DRAINED. AN S IN FRONT OF THE SPECIES NAME INDICATES THAT THE SPECIES IS A SUSPENSION FEEDER. THE ERROR ESTIMATES ARE TWICE THE STANDARD ERROR

			Number of individuals				
			Control			*Oil*	
	Mean control	$\bar{x}$ *oil*	*1*	*5*	*8*	*2*	*9*
Asychis elongata	73·7	22·5	60	82	79	29	16
Ninoë nigripes	5·0	7·0		2	13	4 (1)	2 (1)
**Glycera americana*	7·0	7·0	7	7	6	8	6
Spiochaetopterus oculatus	2·7			2	6		
S *Chaetopterus variopedatus*	1·3 ± 1·4		2	2			
Nephtys incisa	1·0	2·0	1		2	4	
Pectinaria gouldii	1·7		1	3	1		
Diopatra cuprea	0·3		1				
Notocirrus spiniferous	2·3	1·5	1	1	5	3	
Harmothöe imbricata		1·0				2 (2)	
Nereis virens		9·0				13	5 (4)
Lumbrineris fragilis	1·7				5		
Pherusa affinis	2·7				8		
Clymenella sp.	0·3			1			

S *Hydroides dianthus*	4·0 ± 8·0				12 (12)		
**Crangon septemspinosus*	108·0	28·5	79 (8)	142 (113)	103 (86)	5 (3)	52 (51)
**Neopanope texana*	30·0	8·0	27 (2)	41 (12)	22 (2)	8 (5)	8 (5)
Pinnixa chaetopterana	0·7		2				
**Pagurus longicarpus*	0·7		1	1			
**Libinia emarginata*	0·7		2				
**Ovalipes ocellatus*	0·3		1				
**Carcinus maenas*							
S *Crepidula fornicata*	6·0 ± 7·2	2·0 ± 0	4	13	1	2 (1)	2
S *C. plana*	2·3 ± 0·7	2·5 ± 5·0	2	3	2	5 (5)	
S *Pandora gouldiana*	0·7 ± 0·7				2		
S *Pitar morrhuana*	48·3 ± 18·2		52	62 (1)	31		
S *Anomia simplex*	1·3 ± 1·3		2	2			
S *Ensis directus*	0·7 ± 0·7		1	1			
S *Petricola pholadiformis*	0·3 ± 0·7			1			
Macoma tenta	0·7		1	1			
**Polinices duplicatus*		0·5				1	
**Busycon canaliculata*	0·3				1		
S *Anadara transversa*	1·7 ± 1·8	0·5 ± 1·0	2		3 (1)		1
Cerianthéopsis americanus	9·3	5·5	4	10	14	7	4
Holothurian (*Leptosynapta?*)	1·0		1	1	1		
S *Molgula manhattensis*	6·0 ± 6·9			6 (1)	12 (8)		
**Cerebratulus lacteus*	0·7	1·0		1	1	2	
Anchoa mitchilli	2·0		3	2 (2)	1 (1)		
Total number of individuals			257	387	331	93	96
*Total number of predators			117	192	133	26	66
Total number of suspension feeders			65	90	63	2	2

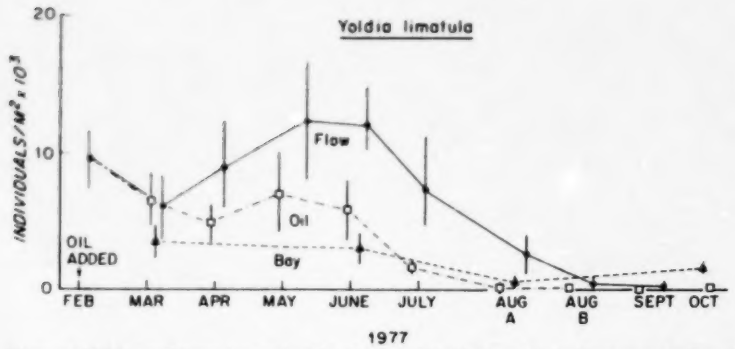

Fig. 5. Mean and 95 % confidence interval of the density of *Yoldia limatula* in Narragansett Bay, flow (control) tanks and the oil tanks from the start of the second oil experiment.

collected. The only suspension feeders to survive in the oil tanks were a few *Crepidula fornicata*, *C. plana* and *Anadara transversa*. The relatively common bivalve, *Pitar morrhuana*, was absent from the oil tanks.

Narragansett Bay meiofauna

As shown in Fig. 6, the meiofauna of the Bay is very rich in individuals, about 8 million per square metre in June and 14 million per square metre in August. As is virtually always the case in muddy sediments, nematodes dominate, constituting 70–87 % of the total meiofauna abundance (5–12 million per square metre). Foraminifera (0·6–1 million or 6–12 %) and harpacticoids (0·4–1·0 million or 5–14 %) are also quite abundant. Juvenile macrofauna (so-called temporary meiofauna) was also abundant in the Bay (0·10–0·25 million per square metre) with more individuals found in the meiofaunal fraction than in the macrofauna proper (300 μm sieve) on all

TABLE 2

MEAN NUMBER OF INDIVIDUALS AND WET WEIGHTS OF LARGE ANIMALS PER TANK. THE CONFIDENCE LIMITS ARE ESTIMATED BY TWICE THE STANDARD ERROR

	Individuals	
	Control	*Oil*
Predators	147·3 ± 45·6	46·0 ± 40·0
Suspension feeders	72·7 ± 17·4	5·0 ± 4·0
Total	325·0 ± 75·3	94·5 ± 3·0
	Wet weight in grammes	
	Control	*Oil*
Predators	174·3 ± 33·6	41·4 ± 1·51
Suspension feeders	607·0 ± 108·0	4·35 ± 1·90
Total	845·1 ± 66·1	78·2 ± 28·9

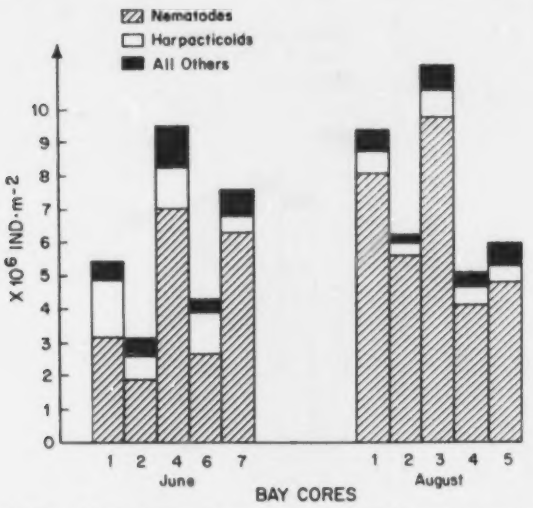

Fig. 6. Field variability of Narragansett Bay meiofauna. 35·3 cm² cores, 0–2 cm layer, 30 June and 10 August, 1977.

three sampling occasions. Other groups were of only marginal numerical importance.

The meiofauna of the experimental ecosystems

After about six months of operation, in February 1977, just before the start of the repeated oil addition experiment, the tanks had what seemed to be a fairly natural meiofaunal community (Fig. 7). No Bay samples were taken at this time, but the data are surprisingly similar to the Bay data from June (upper 2 cm). The variability between the tanks seems no larger than that between cores from the Bay (see Fig. 8). After almost a year, in early August 1977, the three control tanks showed larger variability and only one of them had abundance values comparable with those found in the Bay at that time (Fig. 9). In all control tanks the less abundant groups, such as Turbellaria, kinorhynchs, ostracods and temporary meiofauna, are reduced in comparison with those of the Bay. One possible explanation for this reduction in meiofauna in the control tanks may be predation pressure from the high numbers of decapod predators in those tanks (Table 1).

Oil effects on the meiofauna—chronic, low-level oil exposure

The chronic oil addition (overall mean of 190 ppb in the water column, as described in the previous section on macrofauna) seems to have resulted in a steady decline in the meiofauna, especially evident in the crustacea (harpacticoids and ostracods). The change in abundance of total meiofauna is illustrated in Fig. 10. The

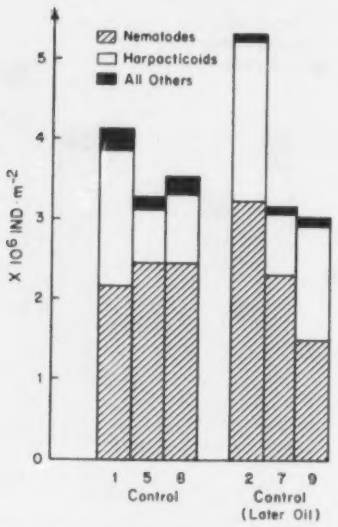

Fig. 7. Meiofauna in upper 2cm of sediment from MERL tanks, February, 1977.

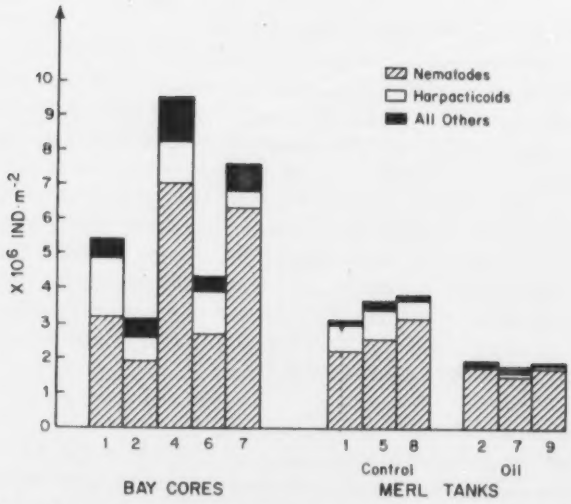

Fig. 8 Meiofauna in upper 2cm of sediment, MERL tanks and diver cores from Station 1, Narragansett Bay, June, 1977.

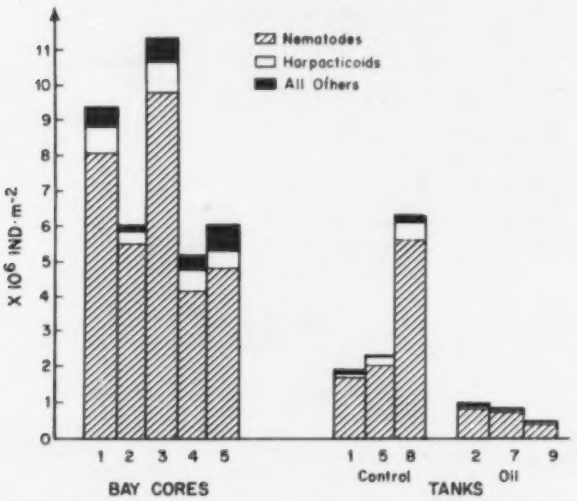

Fig. 9. Meiofauna in top 2 cm of sediment. Bay cores = Narragansett Bay, Station 1, 10 August, 1977. Tanks = MERL tanks, first week of August, 1977.

changes in the oil tanks must be evaluated against a background of decreasing meiofaunal abundance in the control tanks as well, which became especially evident from early August onwards. Table 3 summarises statistically significant differences among the three oil and the three control tanks. The rank sum test (Dixon & Massey, 1957) was used. Diagrams of the abundance of harpacticoids (Fig. 11), ostracods (Fig. 12) and Foraminifera (Fig. 13) show the results graphically.

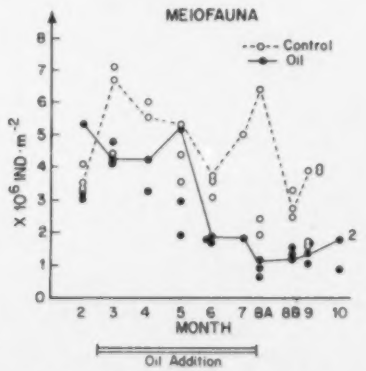

Fig. 10. Abundance of total meiofauna (excluding ciliates and planktonic rotifers) in the MERL tanks. Upper 2 cm of sediment cores, February to October, 1977. The lines follow one tank from each treatment, No. 2 (oil, full line) and No. 8 (control, dashed line).

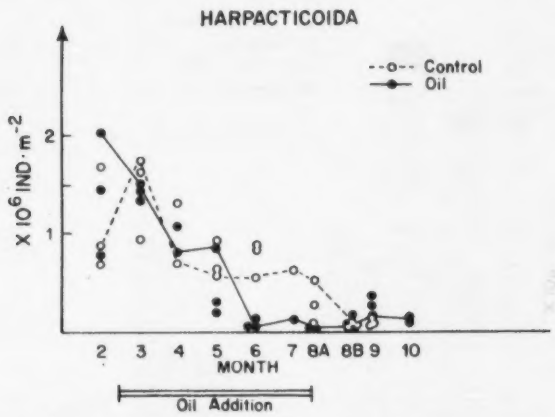

Fig. 11. Abundance of harpacticoid copepods (adults, copepodites and nauplii) in the MERL tanks. Upper 2 cm of sediment, February to October, 1977. The lines follow one tank from each treatment, No. 2 (oil, full line) and No. 8 (control, dashed line).

A tendency for higher total meiofaunal abundance (Fig. 10) in the control systems is evident within two months after the first oil addition and, with the exception of May, it remains significant until the last full set of samples was taken in mid-September, about 50 days after the last oil addition.

The evolution of the meiofaunal community under oil stress is shown in Figs 7–9. Before the first oil addition in the chronic oil experiment in February the tanks were

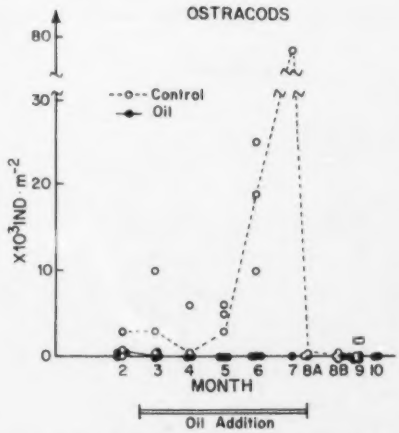

Fig. 12. Abundance of ostracods in the MERL tanks. Upper 2 cm of sediment, February to October, 1977. The lines follow one tank from each treatment, No. 2 (oil, full line) and No. 8 (control, dashed line).

TABLE 3

MEIOFAUNA: STATISTICALLY SIGNIFICANT DIFFERENCES BETWEEN OIL AND CONTROL TANKS. RANK SUM TEST (DIXON & MASSEY, 1957). C = CONTROL TANKS HIGHER, $p = 0{\cdot}10$; O = OIL TANKS HIGHER, $p = 0{\cdot}10$, — = NO STATISTICALLY SIGNIFICANT DIFFERENCE

	Before			*Oil addition*				*After*	
	F	*M*	*A*	*M*	*June*	*July*	*Al*	*A*	*S*
Ciliata	—	O	—	O	—	O			
Foraminifera	C	—	—	O	O	O			
Nematoda	—	C	C	—	C	C	C	C	C
Harpacticoida	—	—	—	—	C	C	C		O
Ostracoda	—	—	C	C	C	C	—	—	—
Total meiofauna (excluding ciliates)	—	—	C	—	C	C	C	C	C

all quite similar (Fig. 7). In June, after four months of oil addition, the oil tanks showed significantly lower total abundance, as well as lower nematode, ostracod and total harpacticoid populations (Fig. 8). The control tanks were similar to Narragansett Bay in community composition and fall within the variability found in a set of five diver-collected Bay cores, but with a lower mean abundance. At the end of the oil additions, in early August, the reduction of the oil tank meiofauna was even more drastic, but at this time two of the three control tanks were also lower than earlier, and outside the range of variability found in a set of five Bay cores (Fig. 9). The heterogeneity within the set of control tanks meant fewer significant differences, but total meiofauna, nematodes and total harpacticoids are still significantly lower in the oil tanks (Table 3).

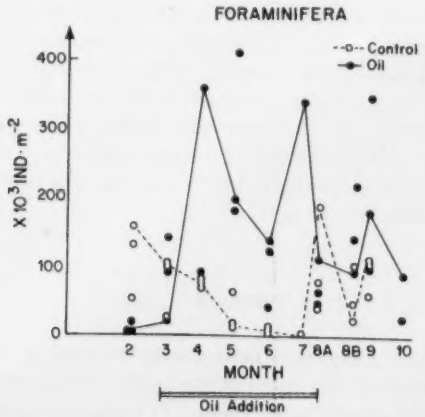

Fig. 13. Abundance of Foraminifera in the MERL tanks, upper 2cm of sediment, February to October, 1977. The lines follow one tank from each treatment, No. 2 (oil, full line) and No. 8 (control, dashed line).

The influence of the oil on the harpacticoid copepods (Fig. 11) is statistically significant by June, when there were significantly fewer harpacticoids in the oil tanks (Table 3), but a larger number of dead individuals. A statistical difference remains as long as the oil additions continue, even though the population is decreasing also in the control tanks. After oil additions were stopped, the difference disappeared within a month and after 50 days there were four times as many harpacticoids in the previously oiled tanks as in the controls – a statistically significant difference.

The other crustacean meiofaunal group usually present in Narragansett Bay is the ostracods (Fig. 12) They seem to be even more sensitive than the harpacticoids to the oil. In February they occurred in low numbers in the samples from two oil and two control tanks, but after oil addition had started only one single specimen was ever found in an oil tank (in March), whereas they gradually increased to a summer peak in the control tanks in June and July. The differences were statistically significant from April to July. Just like the harpacticoids, the ostracods also declined in abundance in the control tanks towards the end of the experiment.

Not all animal abundances were decreased by the oil. From May onwards the abundance of the Foraminifera was significantly higher in the oil tanks than in the controls (Table 3, Fig. 13). The other unicellular group sometimes found in the meiofaunal samples, the ciliates, showed a similar trend, with significantly higher values in the oil tanks within a month (Table 3). The meiofaunal samples only contain the very largest ciliates and have therefore not been included in the meiofaunal totals.

Recovery from oil exposure

After oil additions to the tanks ceased in early August, oil levels in the water decreased rapidly, to below 100 ppb within 4 days, and to about 10–20 ppb after a month. Sediment samples, however, showed no clear decrease over the whole two-month recovery period (Gearing & Gearing, 1978). After one month, the oil tanks were still significantly lower in total meiofauna and nematodes (Table 3), while the harpacticoids were slightly, but insignificantly, higher in the oil tanks (Table 3). After about 50 days, in mid-September, the harpacticoids were more than four times as numerous in the former oil tanks and the difference was statistically significant ($p = 0{\cdot}1$) (Fig. 11, Table 3).

DISCUSSION

In July, when significant differences between the benthos in the MERL oil and control tanks were observed, the levels in the upper 3 cm of the oil tanks average 151 μg/g dry sediment (Wade & Quinn, 1980). The highest concentrations of oil were in the surface flock where concentrations were as high as 527 μg/g dry sediment (Wade & Quinn, in press). After June there was a marked decline in average

macrofaunal and meiofaunal numbers in the control tanks. There could be several reasons for this decline. Phytoplankton primary production was much lower in the control tanks (only about 20% of estimated Bay values; Vargo *et al.*, 1978) and the slow flow resulted in a reduced influx of particulate organic matter in comparison with the Bay. This would lead to lower carbon input to the benthos (both by sedimentation and filtration by suspension feeders) and the effect can be expected to become gradually more severe as the original store of detrital carbon in the sediment is depleted, leaving only the more refractory compounds. The larvae of most species were not carried into the tanks by the slow flow system. A pulse flow system and improvements in plumbing prevented the macrofaunal decline in a subsequent experiment in 1978 (J. F. Grassle *et al.*, 1979).

Another possible reason for the macrofaunal decline is that the invertebrate predators in the tanks were somewhat elevated over densities in the Bay, but we have not yet found a satisfactory way of counting predators in the Bay. The more rapid decline in the total number of macrofaunal individuals in tank 1 than in the other control tanks suggests that a few large predators can have a significant effect on an area less than their normal ambit.

Even though macrofaunal densities were declining in all tanks, oil and control tanks were significantly different ($p < 0{\cdot}05$). A study of marine intertidal colonies on concrete substrata placed in continuous flow microcosms indicates effects on benthic invertebrates at similar concentrations of No. 2 fuel oil to those maintained in the MERL water column (Vanderhorst *et al.*, 1977).

The type of experiment described bridges the gap between toxicity bioassays of single species and other laboratory experiments and observation of the situation in nature following pollution (Cowell, 1977). The experimental ecosystems at MERL may be considered equivalent to a field experiment under highly controlled conditions. In areas where it is extremely difficult to establish adequate controls or areas where the deliberate discharge of oil is prohibited, the MERL approach is the most satisfactory way in which to predict the effects of low level chronic discharge of hydrocarbons.

CONCLUSIONS

1. The benthic components of the experimental ecosystems are similar in structure to the original Narragansett Bay community, replicate well and do not show erratic fluctuations in abundances of individual species.
2. Low additions of No. 2 fuel oil to the experimental ecosystems had a highly significant effect on total macrofaunal numbers when compared with controls. Each of the most common species, *Mediomastus ambiseta*, *Nucula annulata* and *Yoldia limatula*, showed significant differences in population density between oiled and control tanks.

3. The MERL tanks supported a meiofaunal community similar to that of Narragansett Bay for ten months, after which a clear decline in abundance took place, even in the control tanks.
4. The larger macrofaunal animals sampled by sieving all of the sediment showed highly significant differences in total fauna, but most particularly a reduction in suspension feeders in the oiled tanks.
5. The oil levels used in the MERL tanks brought about a drastic reduction in the metazoan meiofauna after five months. The microcrustacea (harpacticoids and ostracods) seemed to be the most sensitive groups. Unicellular meiofauna (Foraminifera and large ciliates), on the other hand, increased in the oiled tanks, probably due to decreased predation and competition.
6. After less than two months without oil additions, a strong recovery was found in the harpacticoid copepods and other meiofaunal groups also showed signs of recovery. The macrofauna showed no signs of recovery in the oil tanks during these two months.

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